



Infectious Diarrhea

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Outline

- Significance & prevalence
- High Risk Circumstances & Populations
- Pathogenesis
- Etiologic Agents
- Diagnostic Approach & Differential
- Management

Overall Significance

- One of most common diseases in world
- 3-5 billion cases of acute infectious diarrhea annually
- Kills 5-10 million people/year
- In the U.S., more than 8 million seek medical attention for diarrhea; costs \$23 billion in medical expenses & lost wages

Diarrhea in children

In the developing world:

- Kills 4 million under age 5 each year
- 1 of every 5 deaths under age 5 due to diarrhea
- Up to 50% of deaths in early humanitarian emergencies may be due to diarrhea

Risks in 3rd World

- Lack of safe water supply
- Contaminated foods
- Poor sanitation
- Overcrowding
- Malnutrition

Global Risks

- Travel
- HIV infection & immunosuppression
- Day Care Centers: fomite spread
 - Also affects staff, household contacts
- Nursing Home/Chronic Care Facilities
- Antibiotics
- Achlorhydria/H2 blocker or PPI therapy

Factors in Emergencies

- Lack of safe, clean water supply
- Contamination of food supply
- Poor sanitation
- Overcrowding
- Malnutrition
- HIV infection & immunosuppression

Diarrhea in the Military

- Long history of big impact on operations
- Resulted in >25% of death in Civil War
- Morbidity > mortality in WWII
 - 497 cases/1000 men in Middle East, 1942
- Gulf War: 57% attack rate
 - 20% had temporary duty loss
 - Causes: ETEC>Shigella>Campylobacter

Pathogenesis

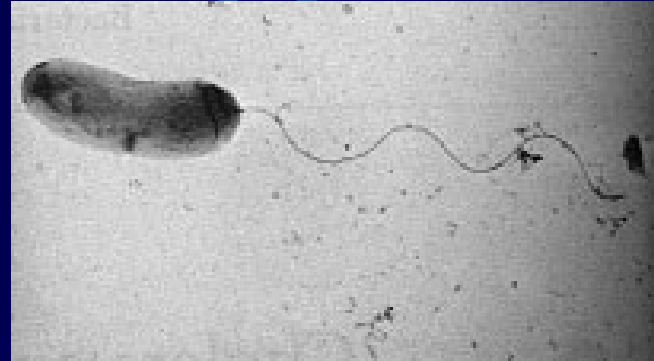
- Stimulation of net fluid secretion
- Mucosal destruction with increased permeability
- Nutrient malabsorption
- Increased propulsive contraction

Etiologic Agents

- Toxin-producing bacteria
- Invasive Bacteria
- Parasites
- Viruses

Toxin-producing bacteria

- Cholera
- Shigella
- ETEC (enterotoxigenic E. Coli)
- EHEC (Enterohemorrhagic/EC 0157)
- Clostridium difficile
- Bacillus cereus



Vibrio Cholera

- Spread in water, undercooked seafood
- Secretion of fluid in small intestine
- Malabsorption of fluid in large intestine
- Rice water stools—large volume, high electrolyte content
- More info: [Cholera](#)

Treatment of cholera

- Oral Rehydration Therapy
- Antibiotics
 - Limit spread of disease by reducing volume & duration of diarrhea
 - Adults: Doxycycline, 300 mg once
 - Children: 6 mg/kg once
 - Alternatives: TTC, Chloramphenicol, Septra, quinolones, erythromycin

Shigella

- Spread by contaminated food, water
- Bloody diarrhea characteristic
- Fever common
- Some carriers asymptomatic; symptoms usually occur in 2-3 days
- More info: [Shigella](#)

ETEC

- Major cause of diarrhea in developing countries & travelers
- Two toxins, one cholera-like
- Causes watery diarrhea, nausea, cramps, low-grade fever
- Rx: TMP-SMX or Bismuth salicylate
- More info: **ETEC**

EHEC (0157)

- Toxin from undercooked food, especially beef
- May be mild or asx, but fever, severe cramps & bloody diarrhea common
- Cause of hemolytic uremic syndrome
- More info: [EHEC](#)



C. difficile

- Antibiotics facilitate overgrowth of normal bowel inhabitant
- Watery diarrhea +/- blood, cramps, fever
- Treatment: oral vancomycin or Flagyl
- More info: [C. difficile](#)

Bacillus cereus

- Aerobic spore former
- In soil, contaminates water & food
—especially rice, survives boiling
- Vomiting within 1-6 hours, diarrhea follows
- More info: Bacillus cereus

Invasive Bacteria

- EIEC (enteroinvasive E. coli)
- Salmonella
- Campylobacter
- Yersinia

Enteroinvasive E. coli

- Symptoms mimic Shigella: bloody diarrhea, fever, cramps
- Thought to be spread by food contamination
- Therapy supportive, usually self-limited without requiring antibiotics
- More info: EIEC

Salmonella

- Contaminates raw eggs, dairy products, poultry, other meats
- Fever, diarrhea, +/- vomiting, can enter bloodstream
- More common in children, in summer
- More info: Salmonella

Campylobacter

- Spread by contaminated water or raw milk
- Causes patchy destruction of walls of small and large intestines
- Diarrhea +/- blood, fever, vomiting, HA, abd pain
- More info: Campylobacter

Yersinia

- Contaminates dairy products, poultry, & other meat
- Multiple syndromes, including sepsis in immunosuppressed; appendicitis-like; fever/diarrhea/abd pain in children; & extra infections
- More info: Yersinia



Parasites

- Giardia lamblia
- Entamoeba histolytica
- Cryptosporidium

Giardia

- Zoonosis, animals contain
- Water
- Diarrhea, abd pain, gas
- Treat w/ Flagyl



Entamoeba histolytica

- Diarrhea, often Bloody, fever, abd cramps
- Onset usually 2-4 wks, range days-mos
- Treat w/ Flagyl
- More info: Amoeba



Cryptosporidium

- Watery diarrhea, emesis, cramps, fever
- Transmitted in water or fecal-oral
- More pathogenic in immunosuppressed, especially AIDS
- Best treatment is restoring immune fn, (e.g., several drugs for HIV), azithromycin shows some efficacy
- More info: [Cryptosporidium](#)

Viruses

- Rotavirus
- Norwalk Agent
- Calciviruses

Rotavirus Epidemiology

- Most common cause of acute gastroenteritis in children worldwide
- Infects almost all children by age 4
- Kills nearly one million annually
- Fecal-oral transmission, lasts for days on toys & countertops
- More common in winter

Rotavirus features

- Ranges from asymptomatic to severe
- 3-9 days' fever, abd. pain, diarrhea
- Wheel-shaped RNA virus, seen in stool on EM, or diagnosed by ELISA
- Prevent w/ handwashing & hygiene
- Rx severe cases w/ ORS or IV fluids
- More info: Rotavirus

Norwalk Agent

- Fecal-oral transmission; associated w/ raw oysters and clams
- Nausea, vomiting, diarrhea, cramps
- Symptoms start @ 1-2 days, last 2-3
- Hydration is only treatment
- More info: Norwalk

Caliciviruses

- Known as Norwalk-like viruses—small, single-stranded RNA viruses
- Associated with ingestion of raw shellfish, fecal-oral transmission
- Cause diarrhea, vomiting, fever, headache

Diagnostic Approach

- Often based on clinical grounds alone
 - Diagnostic studies often unavailable
 - Symptoms often resolve, or require prompt treatment, before results can be obtained
 - Clinical features that may be helpful include exposure/risk factors; stool volume, presence of blood, associated symptoms

Diagnostic Studies

If available, may include:

- Fecal leukocytes
- Stool culture
- Ova and parasites
- C. difficile titer
- Amoeba titers

Management

- Treatment often empiric
- Oral rehydration therapy (ORT)
- IV hydration
- Anti-diarrheals: anti-motility, absorbent, and anti-secretory agents
- Antibiotics

Oral Rehydration

- Safe, simple, cheap
- 1st use: Bangladesh, 1971—
dramatic reduction in mortality
- Premix, or use H₂O, salt, sugar
- Treats *and prevents* diarrhea
- Sodium-glucose co-transport
- Mothers can administer ORT

Oral Rehydration

- Glucose-based ORT may paradoxically increase fecal fluid loss
- Rice-based ORT may more quickly relieve symptoms, ? More available
- High amylose maize (amylase-resistant) based ORT shortens diarrhea duration and reduces stool volume (NEJM 2000;342:308-13, access here: ORT)

Making ORT with IV fluids

- 390 cc NS
- 400 cc D5W
- 10 cc KCl (2meq/l)
- 30 cc NaHCO₃ (1 meq)
- 170 cc water

Making ORT w/ sugar & salt

- 9 teaspoons table sugar
- $\frac{1}{2}$ teaspoon salt
- $\frac{1}{2}$ teaspoon baking soda
- $\frac{1}{4}$ teaspoon potassium chloride
 - Try bananas, oranges, or tomatoes if N/A
- 1 liter of water

Rice-based ORT

- 100 g uncooked rice
- 1 liter water

Boil rice 10 mins until it pops. Drain water from rice into container, squeeze more out with spoon, then add water to what you collected to make 1 liter.

Indications for IV hydration

- Severe dehydration (hypotension, shock, stupor, coma)
- Ileus—abd distention a/o absent BS
- Persistent severe vomiting
- Excessive stool output (10cc/kg/hr)
- Severe glucose malabsorption

More on IV hydration

- Replace fluid deficit as well as continuing losses
- Transition to ORT as soon as dehydration improves and/or gut seems to be working again

Antimotility Agents

- Increase segmental & decrease propulsive contractions
- Prolong transit time
- Loperamide better than diphenoxylate in clinical trials
- Opiates have similar effect on motility
- Limit to 48 hours; may prolong illness & can cause ileus or toxic megacolon

Absorbent agents

- Nonabsorbable resins, e.g. cholestyramine
- Bind *C. difficile* toxin
- Speed toxin clearance, promote mucosal recovery—for multiple pathogens
- Stop 5 days after symptoms resolve

Antisecretory agents

- Decrease propulsive contractions
- Increase mucosal absorption
- Decrease mucosal secretion
- Enhance electrolyte & H₂O reabsorption
- Most useful in AIDS-associated diarrhea
- Ex.: octreotide

Antibiotics

- Not indicated for most cases of simple, watery diarrhea
- Most helpful for:
 - Shigella, ETEC, amebiasis, giardia, cholera, S. typhi
 - May help for cryptosporidium, other salmonella
 - Not useful for viral, EIEC

Summary

- Diarrheal diseases common, costly
- Children, travelers, military, displaced persons among high risk groups
- Empiric treatment with ORT most often effective